

**Citation:**

Koh-Banerjee P, Chu NF, Spiegelman D, Rosner B, Colditz G, Willett W, Rimm E. (2003). Prospective study of the association of changes in dietary intake, physical activity, alcohol consumption and smoking with nine-year gain in waist circumference among 16,587 US men. *American Journal of Clinical Nutrition*, 78, 719-727.

**PubMed ID:** [14522729](#)

**Study Design:**

Prospective Cohort Study

**Class:**

B - [Click here](#) for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

To examine the association of changes in dietary intake, physical activity, alcohol consumption and smoking in a nine-year gain in waist circumference among cohort of 16,587 men.

**Inclusion Criteria:**

16,587 male health professionals aged 40-75 years, in which the researchers have a complete set of predictor and outcome information from 1986-1996.

**Exclusion Criteria:**

- 17,584 men who either died (N=1,751) or developed cardiovascular disease, cancer or diabetes (N=15,833)
- 17,358 men who failed to report waist circumference measures, body weights or dietary data.

**Description of Study Protocol:****Recruitment**

Participants were a part of the *Health Professional's Follow-up Study*.

**Design**

- Prospective cohort study
- Data collected was self-reported questionnaires, height and weight and waist circumference measures.

**Dietary Intake/Dietary Assessment Methodology**

131-item semi-quantitative food-frequency questionnaire (FFQ).

### **Blinding Used**

Not applicable.

### **Intervention**

Not applicable.

### **Statistical Analysis**

- Baseline characteristics: Mean calculations and ANOVA for comparison
- Multivariate linear regression analysis: To explain lifestyle factors changes and their association with waist circumference.

## **Data Collection Summary:**

### **Timing of Measurements**

- FFQ taken in year 1986, 1990 and 1994
- Physical activity information collected in 1986 and biennially thereafter
- Medical history collected at baseline; biennially participants were mailed questionnaires to update exposure or any disease diagnosis since last questionnaire.

### **Dependent Variables**

Variable 1: Waist circumference measured by participants who were sent tape measures to assist in self-reporting waist and hip circumference. Instructions were provided.

### **Independent Variables**

- Variable 1: Dietary data measured by FFQ
- Variable 2: Physical activity measured in 1986 and biennially; questionnaire regarding average time per week over a year in specific activities.

### **Control Variables**

All multivariate models controlled for:

- Baseline age
- Baseline waist circumference (quartiles)
- Baseline body mass index (BMI) (quartiles)
- Baseline and change in total calories (continuous variables)
- Change in smoking status (categorized as non-smokers, habitual smokers, new smokers and quitters)
- Baseline (continuous variable) and change (quintiles of total physical activity)
- Baseline and change in alcohol intake (continuous variables).

## **Description of Actual Data Sample:**

- *Initial N*: 51,529 males
- *Attrition (final N)*: 19,587 healthy males who have complete set of predictor and outcome

information for the study period of 1986-1996

- *Age*: 40-75 years
- *Ethnicity*: No indication of ethnicity
- *Other relevant demographics*: All participants were college educated males working in health related fields
- *Anthropometrics*: No indication of baseline anthropometric differences or similarities
- *Location*: None mentioned.

## Summary of Results:

**TABLE 1: Selected Characteristics by Age Category for 16,587 Men in the Health Professionals' Follow-Up Study<sup>1</sup>**

Age Group in 1986			
	40-49 years (N=7,577)	50-59 years (N=5,314)	60-75 years (N=3,696)
Age, 1986 (years)	43.8±2.9 <sup>2</sup>	54.3±2.8	64.8±3.7
Waist (cm) 1987-1996	92.7±5 <sup>3,4</sup>	94.7±8.4	95.1±8.2
Waist change, 1987-1996 (cm)	96.6±10.0 <sup>3,4</sup>	98.0±9.7 <sup>4</sup>	2.3±6.6
BMI change, 1986-1996 (kg/m <sup>2</sup> )	1.1±1.7 <sup>3,4</sup>	0.7±1.5 <sup>4</sup>	0.1±1.5
Hypercholesterolemia, 1986 (%) <sup>5</sup>	7.5 <sup>3,4,6</sup>	11.3	12.0
Hypertension, 1986 (%) <sup>5</sup>	10.5 <sup>3,4</sup>	16.7 <sup>4</sup>	23.3
Non-smokers, 1996 (%)	91.3	91.2	93.6
Habitual smokers, 1996 (%)	4.3 <sup>4</sup>	4.4 <sup>4</sup>	2.7
New smokers, 1996 (%)	1.2 <sup>4</sup>	0.8	0.7
Quitters, 1996 (%)	3.3	3.5	3.1

<sup>1</sup> MET, metabolic equivalent task

<sup>2</sup> X±SD

<sup>3</sup> Significantly different from group 2 (50-59 years old), overall rate of P<0.05

<sup>4</sup> Significantly different from group 3 (60-75 years old), P<0.05

<sup>5</sup> A professional diagnosis was self-reported on the questionnaire

<sup>6</sup> X.

**TABLE 2: Estimated Adjusted Nine-year Waist Change Among 16,587 Men in the Health Professionals' Follow-Up Study Per Unit Change in Dietary Factors<sup>1</sup>**

Lifestyle Factor	Age-adjusted		Multivariate <sup>2</sup>		Multivariate <sup>3</sup>	
	Waist Change (cm)	P	Waist Change (cm)	P	Waist Change (cm)	P
Increase in total fat intake by 5% of energy	0.30±0.04	<0.001	0.27±0.05	<0.001	0.07 ±0.05	0.11
Replacement of polyunsaturated fats (by 2% of energy) <sup>4</sup>						

With <u>trans</u> fats	0.74±0.21	0.005	0.77±0.21	<0.001	0.52 ±0.19	0.007
With <u>saturated</u> fats	0.06±0.05	0.24	0.23±0.10	0.03	0.03 ±} 0.10	0.77
With <u>monounsaturated</u> fats	0.10±0.11	0.38	-0.05±0.11	0.69	-0.11 ±0.10	0.29
<b>Replacement of carbohydrates (by 2% of energy)<sup>5</sup></b>						
With <u>trans</u> fats	1.21±0.19	<0.001	0.77±0.21	<0.001	0.53 ±0.19	0.007
With <u>saturated</u> fats	0.32±0.04	<0.001	0.27±0.07	<0.001	0.09 ±0.06	0.14
With <u>monounsaturated</u> fats	0.23±0.04	<0.001	-0.02±0.08	0.72	-0.06 ±0.05	0.24
With <u>polyunsaturated</u> fats	0.16±0.07	0.02	0.02±0.08	0.82	0.06 ±0.07	0.45
<b>Increase in total fiber intake by 12g per day</b>	-0.64±0.09	<0.001	-0.63±0.10	<0.001	-0.23 ±0.09	0.008

<sup>1</sup> X±SE

<sup>2</sup> All multivariate models controlled for baseline age (continuous variable), baseline waist circumference (quartiles), baseline BMI (quartiles), baseline and change in total calories (continuous variables), change in smoking status (categorized as non-smokers, habitual smokers, new smokers, and quitters), baseline (continuous variable) and change (quintiles) in total physical activity and baseline and change in alcohol intake (continuous variables). All multivariate models controlled for baseline age (continuous variable), baseline waist circumference (quartiles), baseline BMI (quartiles), baseline

<sup>3</sup> Additionally controlled for change in BMI (quartiles)

<sup>4</sup> Model simultaneously controlled for baseline and changes in intakes of total fat, trans fat, saturated fat and monounsaturated fat (as percentage of energy)

<sup>5</sup> Model simultaneously adjusted for baseline and changes in intakes of protein and all fat subtypes (as percentage of energy).

**TABLE 3: Estimated Adjusted Nine-year Waist Change Among 16, 587 Men in the Health Professionals' Follow-Up Study Per Unit Change in Smoking Status and Alcohol Consumption/**

Lifestyle Factor	Age-Adjusted		Multivariate <sup>2</sup>		Multivariate <sup>3</sup>	
	Waist Change (cm)	P	Waist Change (cm)	P	Waist Change (cm)	P
<b>Change in smoking status</b>						
Non-smokers (reference group)	--		--		--	
Habitual smokers	0.40±0.26	0.12	-0.68±0.26	0.01	-0.35±0.23	0.13
New smokers	-0.40±0.50	0.42	-0.55±0.48	0.25	-0.22±0.44	0.61
Quitters	1.95±0.32	<0.001	1.98±0.32	<0.001	0.77±0.30	0.009
<b>Increase in alcohol consumption by 12g per day</b>	0.06±0.06	0.29	-0.05±0.06	0.94	-0.03±0.05	0.52

<sup>1</sup> x±SE

<sup>2</sup> All multivariate models controlled for baseline age (continuous variable), baseline waist circumference (quartiles), baseline BMI (quartiles), baseline and change in total calories (continuous variables), change in smoking status (categorized as non-smokers, habitual smokers, new smokers and quitters), baseline (continuous variable) and change (quintiles) in total physical activity and baseline and change in alcohol intake (continuous variables)

<sup>3</sup> Additionally controlled for change in BMI (quartiles).

## Other Findings

There were no significant (NS) associations observed for total alcohol consumption and nine-year waist circumference.

## Author Conclusion:

- Changes in modifiable lifestyle factors were significantly associated with nine-year waist gain
- Sedentary behavior, represented by TV watching in this study, was significantly related to increases in abdominal adiposity independent of physical activity, and vigorous physical activity was associated with waist gain
- Increase walking volume was NS related to reduced waist circumference; while, increase in walking pace was inversely associated with waist gain
- The current study is the first to report the association between changes in trans fatty acid intake and increases in abdominal adiposity
- The results of this study support the greater importance of the type of fat consumed than of the quantity of fat in the diet
- The research adds to the growing discussion of the adverse health consequences associated with trans fats.

## Reviewer Comments:

None.

## Research Design and Implementation Criteria Checklist: Primary Research

### Relevance Questions

- |    |                                                                                                                                                                                                         |     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | Yes |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?                                                                             | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?                                                    | Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies)                                                                                                                        | Yes |

### Validity Questions

- |      |                                                                                               |     |
|------|-----------------------------------------------------------------------------------------------|-----|
| 1.   | Was the research question clearly stated?                                                     | Yes |
| 1.1. | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified? | Yes |

1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
<b>2.</b>	<b>Was the selection of study subjects/patients free from bias?</b>	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
<b>3.</b>	<b>Were study groups comparable?</b>	N/A
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
<b>4.</b>	<b>Was method of handling withdrawals described?</b>	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes

4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
<b>5.</b>	<b>Was blinding used to prevent introduction of bias?</b>	N/A
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
<b>6.</b>	<b>Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?</b>	N/A
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
<b>7.</b>	<b>Were outcomes clearly defined and the measurements valid and reliable?</b>	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes

7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
<b>8.</b>	<b>Was the statistical analysis appropriate for the study design and type of outcome indicators?</b>	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	???
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
<b>9.</b>	<b>Are conclusions supported by results with biases and limitations taken into consideration?</b>	N/A
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
<b>10.</b>	<b>Is bias due to study's funding or sponsorship unlikely?</b>	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes